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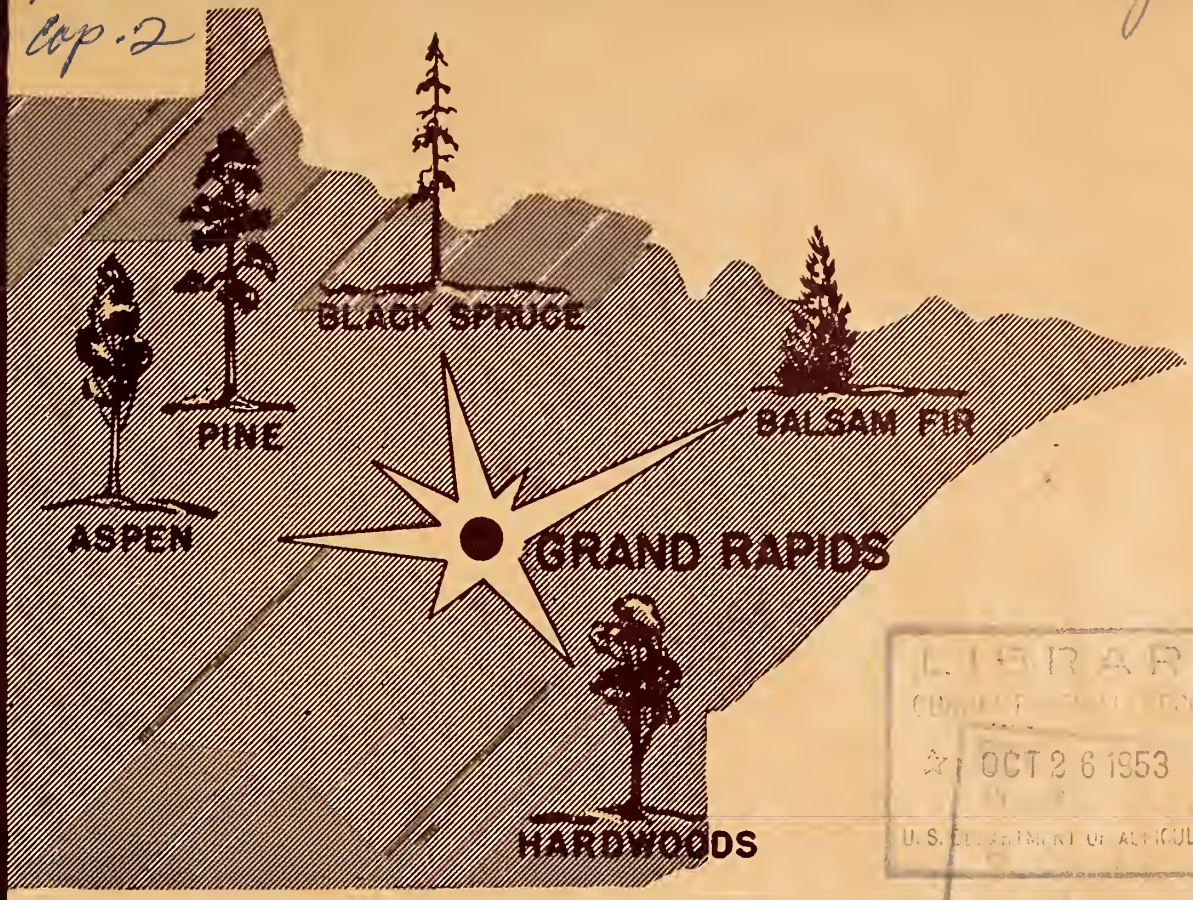

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THE WORK AREA AND PROGRAM OF THE

HEADWATERS FOREST RESEARCH CENTER

GRAND RAPIDS, MINNESOTA

LAKE STATES FOREST EXPERIMENT STATION
FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE

JUNE 1953

MISCELLANEOUS REPORT NO. 24

Territory Served by the

Lakes States Forest Experiment Station

ST. PAUL, MINNESOTA

☆ L.S.F.E.S. Headquarters
○ Research Centers
△ Experimental Forests

Station Director ..... M. B. Dickerman

Forest Management ..... R. D. McCulley

Forest Economics ..... R. N. Cunningham

The Lake States Forest Experiment Station

The Headwaters Forest Research Center in northern Minnesota is a field unit of the Lake States Forest Experiment Station. The Station, in turn, is one of eleven forest experiment stations through which the Forest Service of the U. S. Department of Agriculture conducts regional forest research.

The Lake States Forest Experiment Station carries on a cooperative forest research program in Michigan, Wisconsin, Minnesota and North Dakota. Its headquarters, maintained in cooperation with the University of Minnesota, are at University Farm, St. Paul, Minnesota.

Cooperating with the Lake States Forest Experiment Station in furthering forest research activities are more than 40 organizations, including forest industries, educational institutions, state forestry departments, forest landowners, and others. By using staff, facilities, land, and cash contributions of cooperators, a diverse and comprehensive forest research program is made possible.

Research findings are made available currently through Station Papers, Miscellaneous Reports, and a quarterly series of Technical Notes. More comprehensive reports are published as government bulletins or articles in scientific and trade journals.

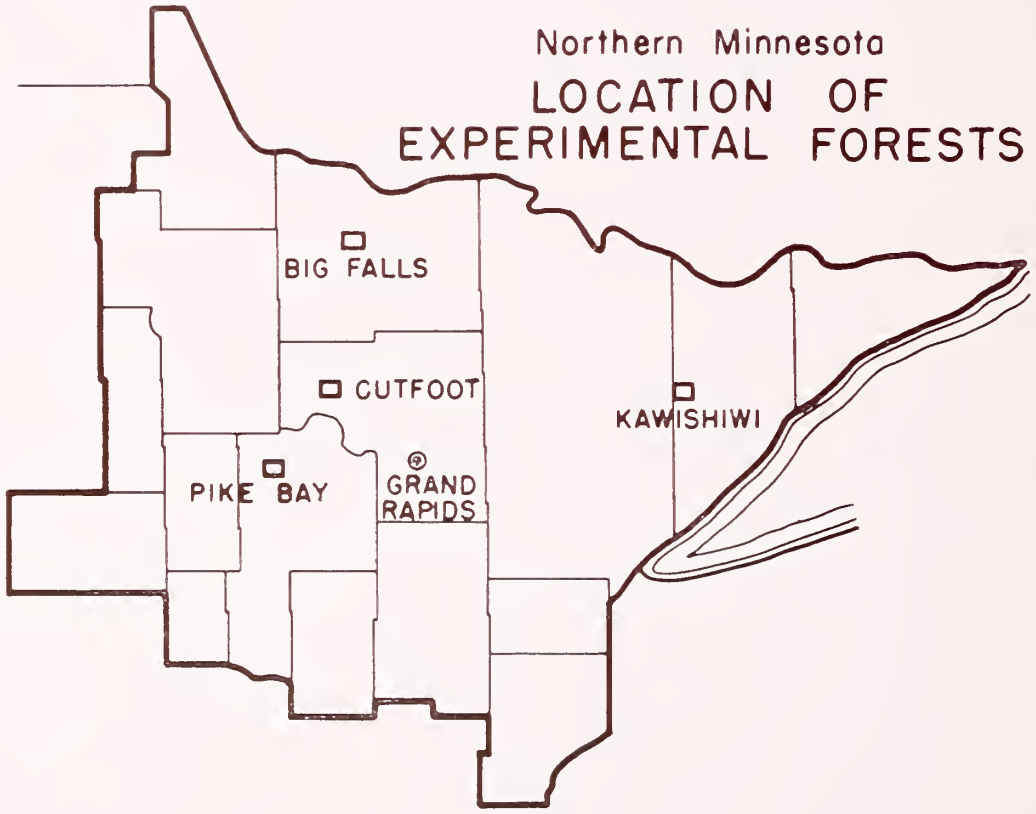
Additional information about the Station and its work may be obtained from the Director, Lake States Forest Experiment Station, University Farm, St. Paul 1, Minnesota.

Forest Management research studies how to obtain natural reproduction when mature timber is cut.

HEADWATERS FOREST RESEARCH CENTER

Established in 1946 with offiees in Grand Rapids, Minnesota, the Headwaters Forest Researeh Center is responsible for the forest management research program of the Lake States Forest Experiment Station in northern Minnesota. Programs locally of greatest importanee are given priority in the researeh program. Most of the Station's work in management of natural pine and in the blaek spruee type is concentrated here. So is a large share of the aspen and balsam fir research.

An Advisory Committee made up principally of practieing foresters from land management agences, both public and private, meets periodically to aid in planning the work. This helps the Station to maintain a balaneed research program and to make available findings of interest and value to all forest land managers.

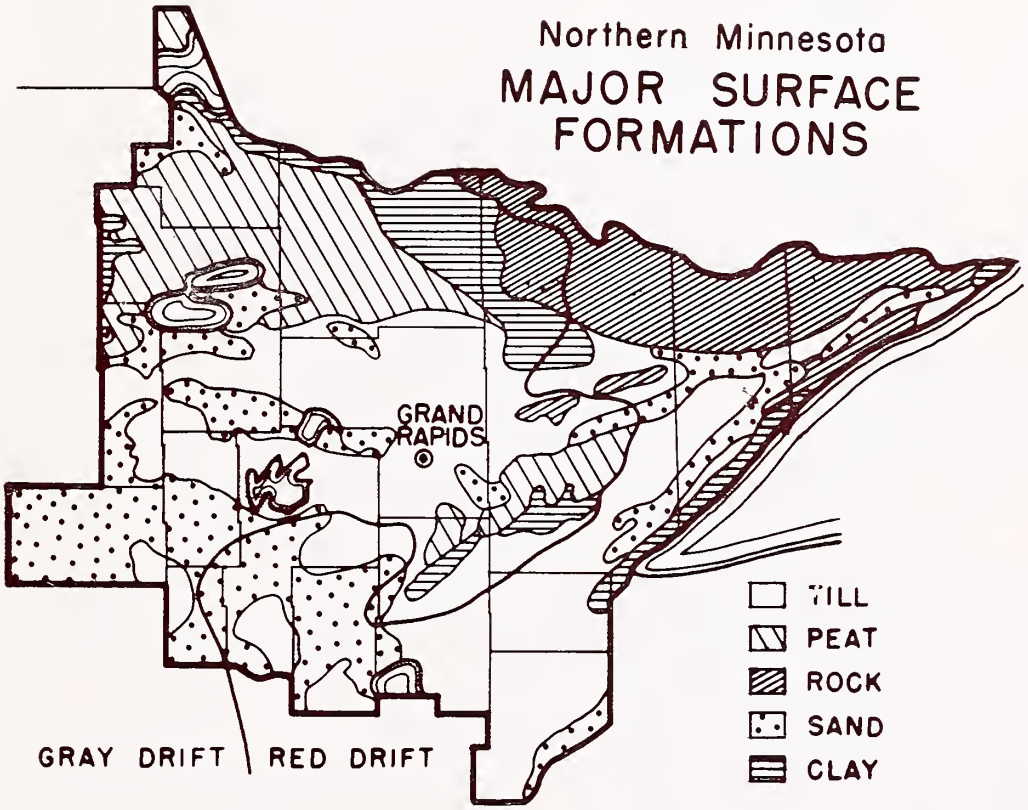


Field work is coneentrated insofar as possible on formally established experimental forests. The Cutfoot in Itasea County and Pike Bay in Cass County are both on the Chippewa National Forest. The Kawishiwi in Lake County is on the Superior National Forest, and in Kooehieh ing County is the Big Falls Experiment Forest on the Kooehieh ing State Forest. When experimental forests do not provide conditions neeessary for speeifie studies, study plots are established elsewhere throughout the territory. They are loeated only on lands where adequate proteetion for the life of the experiment is assured.

CLIMATE AND SOILS

The Headwaters Research Center territory has a continental climate with low annual precipitation (22 - 30 inches), a short growing season (90 - 130 days), and cold winters. Three major drainages — the Mississippi, Lake Superior, and the Red River of the North — have their headwaters in the area.

It is typical glaciated country with many lakes and much variety of topography and soils. Much of the area is flat or gently rolling with fairly uniform soils, large shallow lakes, and vast shallow peat deposits. Other areas are rough and broken with much more variable soils and many deep lakes and swamps.

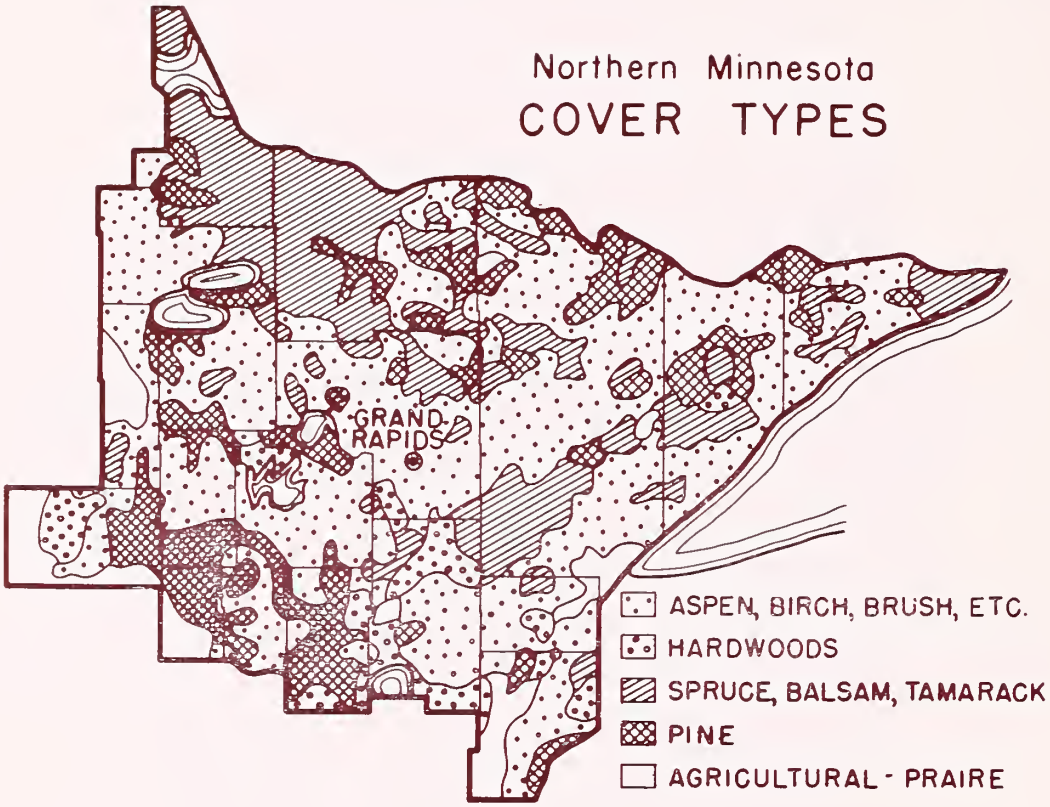


Rock outcrop ridges occur in the eastern portion, particulary along the Canadian border. The upland soils are podsols. In the eastern third of the region the parent material is red glacial drift formed from igneous rock. The remainder is gray drift composed largely of shales and limestones of Manitoba. These gray soils have lime at fairly shallow depths, are heavier, and are generally more fertile than the acidic red drift.

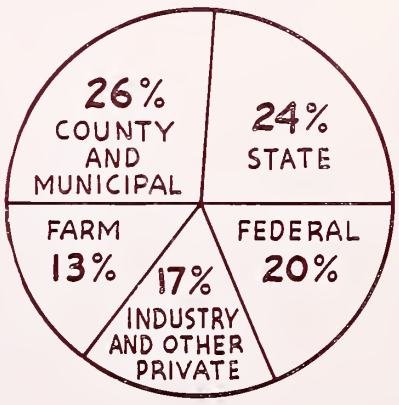
DISTRIBUTION OF FORESTS

Until 1870 much of northern Minnesota was heavily timbered with stands of pine, spruce and fir. By 1930 the great bulk of these original forests had been cutover or burned. Where pine and spruce once dominated, today aspen, balsam fir, and hardwoods, or in many places brush, clothe the stumplands of a half-century ago. Agriculture, mining and a thriving tourist business have come to stay, but four-fifths of the land remains in forest. About 13,900,000 acres (71%) are classified as commercial forest.

The general forest distribution may be visualized from the type map below. About half the area supports aspen-birch. There are extensive areas of swamp conifers and balsam fir of which the spruce and tamarack bogs in northern and southeastern sections are outstanding. Pine types are scattered throughout the territory and the bulk of the hardwood forests are in the southern portion.



Seventy per cent of northern Minnesota's forest land is in public ownership; industrial and other private owners control 17 per cent, and 13 per cent is on farms. In the interests of good administration some adjustments in the ownership pattern are needed. Even so, public forest will always account for a large share of the state's output of forest products.



CONDITION OF THE TIMBER RESOURCE

The timber resource in northern Minnesota is in transition from the "cut-over area" to second growth. Aspen and birch, the common pioneer species on cutover lands, predominate. Over three-fourths of the area supports seedling and sapling stands or is understocked. The following table shows the acreage of commercial forest land by cover types and size classes.

Commercial Forest Area of Northern Minnesota
By Cover Types and Stand Classes
(1950 Estimates)

Forest Cover Type	Saw timber	Pole timber	Seedlings & saplings	Understocked & denuded	All stand classes
	Acres	Acres	Acres	Acres	Acres
White Pine	80,000	20,000	60,000	140,000	300,000
Red Pine	50,000	30,000	90,000	80,000	250,000
Jack Pine	160,000	330,000	400,000	200,000	1,090,000
Spruce-Fir	140,000	280,000	500,000	280,000	1,200,000
Black Spruce	70,000	350,000	750,000	830,000	2,000,000
Tamarack	20,000	140,000	250,000	530,000	940,000
Cedar	40,000	110,000	200,000	200,000	550,000
Hardwoods	160,000	220,000	460,000	230,000	1,070,000
Aspen-Birch	470,000	980,000	3,680,000	1,370,000	6,500,000
Total	1,190,000	2,460,000	6,390,000	3,860,000	13,900,000

Total growth in our forests about equals the annual harvest, but the softwood species, especially spruce and pine, are being overcut, and the hardwoods, particulary aspen, are not being utilized to full capacity. We are not growing enough of certain kinds of timber to meet our needs for lumber and some other products.

FOREST INDUSTRIES

The present forest industries in northern Minnesota include four paper mills, two insulation mills, a match factory, a hardboard factory, five box factories, about 600 sawmills of various sizes, a number of miscellaneous wood-using plants and some twenty brokers handling round-wood products.

Although only a part of Minnesota's paper industry is located in the research center territory, the northern forests supply the wood to all seven paper mills and three insulation plants in the state, and export a large volume of wood to Wisconsin's paper mills.

THE FOREST MANAGEMENT OUTLOOK

Although Minnesota's forests received a setback from early logging and fires, prospects for wise use of the timber resource are good. The state of Minnesota now has a relatively large staff of technical foresters. Fire protection facilities are vastly better than in former days. Many counties are showing an active interest in managing their tax-forfeited lands. State nursery facilities are expanding.

Timber-using industries are managing considerable acreages of productive forest land, and many have sizable staffs of foresters. The National Forests have been managed on a sustained-yield basis for several decades. Extension foresters are encouraging better practices on many farm woodlots.

The University of Minnesota is providing professional training and research. And through its forest research program the Lake States Forest Experiment Station is making a substantial contribution toward improved forest management.

These combined efforts are bearing fruit and there is every reason to believe that the trend of forest depletion is being reversed. Through continued progress it should be possible eventually to raise the level of forest production to support a forest industry several times its present size.

FOREST MANAGEMENT PROBLEMS

Most forest management work has one or more of three major objectives: (1) improving yields of forest products, (2) improving quality of stands and products, (3) improving utilization of low-value species and products. In striving to meet these objectives a number of problems are usually encountered in each forest type. Some of the more important problems are touched on here.

Aspen

Aspen came in after logging and fire, and now covers almost half of the territory. It is a short-lived species producing sawlogs and veneer on good sites and pulpwood on medium sites, but on very poor soils it will not attain merchantable size. Research is needed to help improve quality and yield on good soils, make better yield predictions and increase utilization on medium and poor sites, and aid in converting the poor sites to production of conifers that will grow on these soils.

Swamp Conifers

The merchantable supply of black spruce, the premium pulpwood species, is shrinking. The most urgent problems needing research are ways to extend yields from present stands and to assure regeneration, especially on good sites, when these stands are removed. Extensive areas of tamarack are growing into merchantable sizes. To best manage this increasing resource requires study in the whole field of tamarack silviculture, particularly regeneration, thinning,s and intermediate cuts. White-cedar is fading in commercial importance but will remain a valuable wildlife food species if ways to perpetuate it can be found.

Pine

Red and white pines were once the important species on several million acres of northern Minnesota. These were the lodestar that led the early loggers into the territory. Although reduced by logging and fire to a combined area of only about one-half million acres, they are still of great economic importance, particularly red pine. Jack pine, a pioneer tree that will grow well on light soils, occupies about a million acres. It has more recently come into its own as a pulpwood, lumber, and pole species.

Red and jack pines have been studied extensively and considerable management information is available. Current research problems involve determination of proper density of growing stock, most profitable cutting cycles, methods of cutting best adapted to production of various products, and restoration of pine on much of the land it formerly occupied. Study is needed in the whole field of white pine management, but because this species is subject to severe losses from blister rust, weevil, and rot it has been given lower priority than the other pines.

Balsam Fir - White Spruce

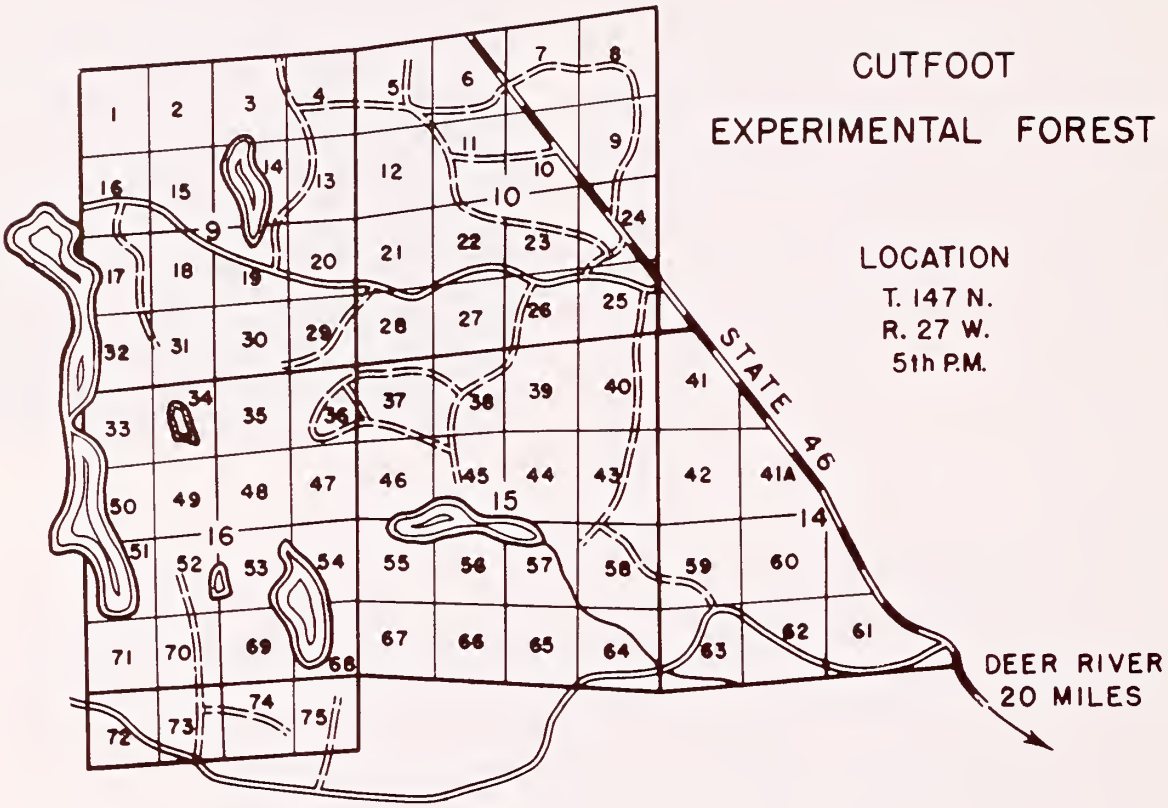
This type, the ultimate natural forest cover on much of the land in the territory, is increasing in both size and importance. Balsam fir is gaining in favor and use as a quality pulping species, and is slowly extending its acreage by invading stands of other species. Important research problems include methods of reducing mortality and increasing present low yields, improving quality of the stands by increasing the proportion of white spruce, restoring balsam fir and spruce to much land now in brush and poor hardwoods, and improving utilization of the stands that are cut.

Hardwoods

Mixed Hardwoods occupy about one-half million acres, a good deal of which had white pine in mixture, and there is another one-half million acres of lowland hardwoods. Sugar maple, a valuable tree elsewhere, is of poor quality in much of the area. Major problems are utilization of low-value trees such as maple, elm, and black ash, and methods of increasing the proportion of better oaks, yellow birch, basswood, and conifers.

OTHER PROBLEMS

The fields of regeneration, forest insects, forest wildlife, and fire, present additional problems. More work is needed in reducing costs of plantation establishment by producing cheaper nursery stock and by less expensive methods of ground preparation, planting, and care of plantations. Forest insects, particularly in epidemic stages, and diseases such as cankers and rot cause a constant loss of growth and yield. Hares and deer when overabundant destroy a great deal of reproduction and are sometimes responsible for plantation and regeneration failures. Research is needed in integration of wildlife, recreation, and timber production.



The Cutfoot Experimental Forest was established in 1932. It is representative of the better-stocked red pine and jack pine forests on medium to good sites, although there is considerable acreage in swamp conifers, paper birch, white pine, and other types.

The forest has been subdivided into three units to facilitate research.

1. A Compartment Study Unit, largely in sections 9 and 10, dedicated to intensive rsearch.

2. A Management Unit of 1060 acres in sections 14 and 15, used as a pilot plant for testing financial aspects of pine management.

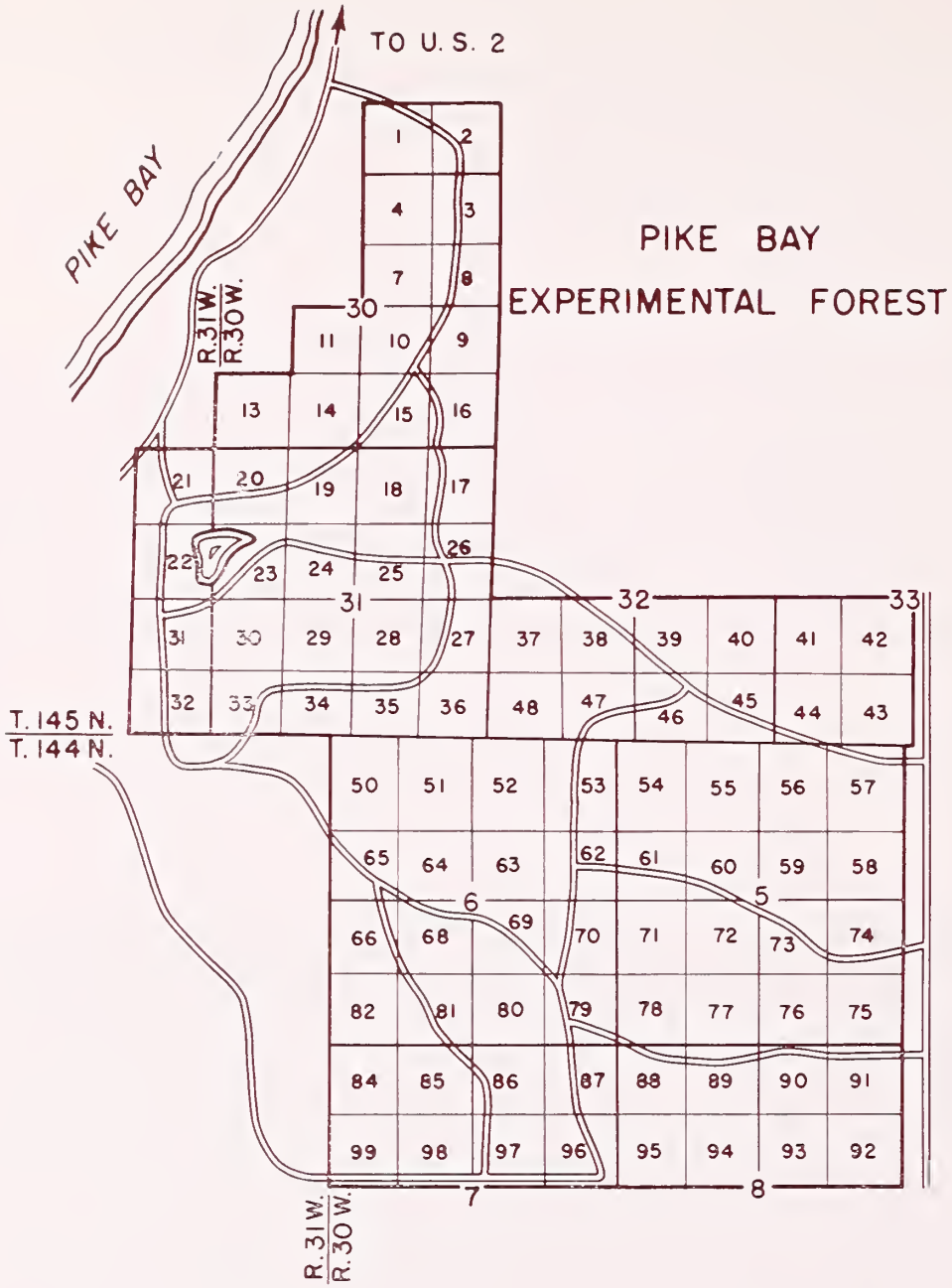
3. A Natural Area (section 16) set aside for study of natural forest development.

Early research on the Cutfoot forest was directed toward obtaining information on methods of reproducing red and jack pines, and getting basic data on growth and yields. A series of plots was established to test various types and degrees of partial cutting in red pine, as contrasted with clearcutting. Slash disposal methods were tried in conjunction with soil scarification as a means of reproducing jack pine. As an outgrowth of this work a Department Circular, "Red Pine Management in Minnesota," was published in 1948.

Findings of these studies are now being tested and refined on a larger scale. Among the current research projects at Cutfoot are the following: Tests of growing stock levels in red pine of intermediate age (blocks 10, 11, 23, 25, 26) to determine the amount of timber that should be carried per acre for maximum returns. A similar study of growing stock levels in young red pine (blocks 73 and 74). Studies of cutting methods in red pine; including cuts from above for early returns, from below for maximum yield of quality sawlogs, and from above and below for integrated utilization of all products (blocks 19, 20, 21, 22, 27, and 29). An investigation of the effect of cutting cycle on growth and returns (blocks 4, 5, 6, and 7).

In addition to the work at Cutfoot, there are numerous other pine studies located outside the experimental forest, some of which are mentioned on page 17.

Counting seedlings in a partially cut red pine stand.



The Pike Bay Experimental Forest was set aside from the Chippewa National Forest in 1932 to provide an area for research in aspen and hardwoods.

This forest includes 4000 acres, mostly former white pine and hardwood - white pine land. Today aspen and low quality hardwoods are the most abundant species on the heavy silt and clay loam soils. An area of sandy soil along the west edge of the forest is stocked with pine and poor aspen.

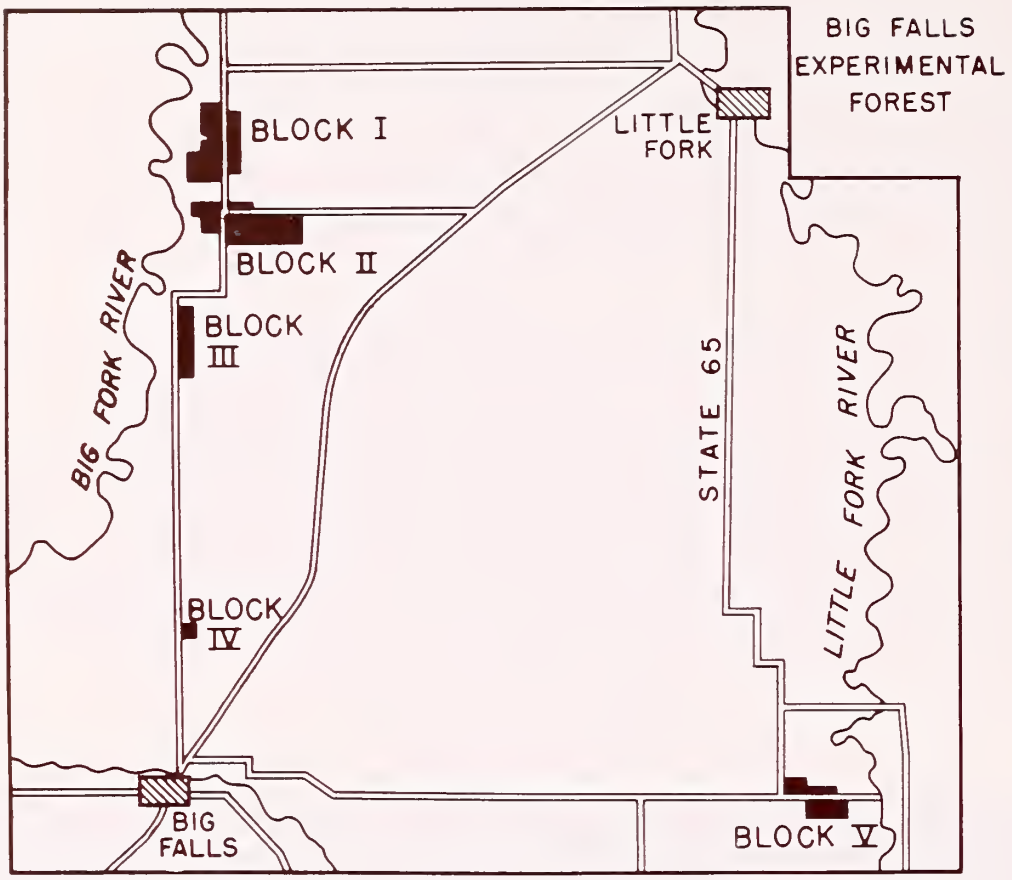
Much of the early research at Pike Bay was pointed toward finding methods of converting low quality aspen to conifers. Quite a number of experimental plantations were established in blocks 1, 33, and elsewhere during that period.

On good soils aspen is a desirable species. Research in aspen management on the better sites was started in 1929, before the experimental forest was established. At that time a thinning in a 20 year old stand was installed about six miles east of Cass Lake along U. S. Highway 2. An experimental commercial thinning in 30 year old aspen is in blocks 62, 70, and 79. A study of thinning in very young stands is located in blocks 63, 64, 68, and 69. A 20 acre "pilot plant" trial of findings from these tests was established in block 99 to provide a larger area in which to study managed aspen. The effect of initial sucker density on subsequent stand development is under investigation in blocks 14 and 19. Mixed stands in which poor quality hardwoods occur with conifers are being managed in the "farm woodland forty" (block 73).

Cutting methods in mature balsam fire are being explored in block 42, while methods of handling mixed aspen-balsam fir forests are under test in blocks 60, 61, and 72.

Seed origin is believed to influence the success of forest plantings with certain species. Several plots have been installed to investigate this factor (blocks 20, 22, 23, and 67). In much of northern Minnesota, hazel and other brush species present serious obstacles to forestry — particularly in the regeneration of pine stands. Excellent areas for research on these problems are available in the Pike Bay Experimental Forest or nearby, and numerous investigations have been initiated.

Measuring an aspen plot after the first commercial thinning.



The Big Falls Experimental Forest was set up for the study of swamp black spruce. Located on land administered by the State of Minnesota in Koochiching County, it was established in 1948 in cooperation with the Minnesota Forest Service. Distributed in five separate blocks north and east of Big Falls, it aggregates 2,000 acres. The black spruce type makes up 1,650 acres of which about half is in stands of merchantable stocking and size. Some 200 acres of spruce are on sites too poor to produce pulpwood but which will grow Christmas trees. Other types represented are tamarack, aspen, balsam fir, and brush.

Experiments are planned and records maintained by the Headwaters Research Center, while timber sales are made and cutting is administered by the Minnesota Forest Service.

The Station started studying black spruce in 1932. Most of the early work was on the Superior National Forest, but a good share was also conducted elsewhere in northern Minnesota. Chief among these first studies were extensive silvical experiments, a series of over 200 growth and mortality plots on commercial cuttings, and four cutting experiments. This work formed the basis for U. S. D. A. Circular "Silvicultural Management of Black Spruce in Minnesota," and pointed out the need for more experimentation in cutting and management methods.

Block 1 of the experimental forest is being used for a comprehensive silvicultural study testing six cutting methods. Other phases of this experiment are investigations in the development of reproduction, logging damage, desirable stocking, and exploration into some factors of site. Block 2 is dedicated as a "management unit" to study financial aspects of swamp forest management. The other blocks are for additional research as the project progresses.

Two cooperative studies of utilization standards for spruce pulpwood were conducted in block 5 and in an area just east of block 2. Another such experiment involving the thinning of a young stand made possible by utilization of small material is located southwest of Squaw Lake on the Chippewa National Forest. Here the silvicultural aspects of various methods and degrees of thinning are being followed.

Measuring tree height in a dense stand of swamp black spruce on moderately deep peat, 4 to 6 feet.

Cutting aspen pulpwood today provides for balsam fir pulpwood tomorrow. Thousands of acres of aspen have a balsam fir understory which will make pulpwood stands a few years after release.

BALSAM FIR - WHITE SPRUCE STUDIES

Because of the widespread occurrence and varying conditions in the balsam fir - white spruce type, management studies of balsam fir are being distributed widely over the territory served by the Headwaters Research Center. On the Pike Bay Experimental Forest, studies are under way to compare the results of commercial clearcutting with those of various degrees of partial cutting in mature stands, and of the growth of balsam fir after release from aspen. Mixed stands of balsam fir and aspen are also receiving attention by means of a cutting study on a commercial scale. These types of cutting studies will be replicated elsewhere in both mature and younger stands.

In northeastern Minnesota, principally on the Superior National Forest, studies so far have dealt mostly with such silvicultural phases as seed production and germination requirements. Enough work has also been done to indicate the difficulty of obtaining reproduction on the extremely brushy sites of the "birch belt" along the North Shore of Lake Superior.

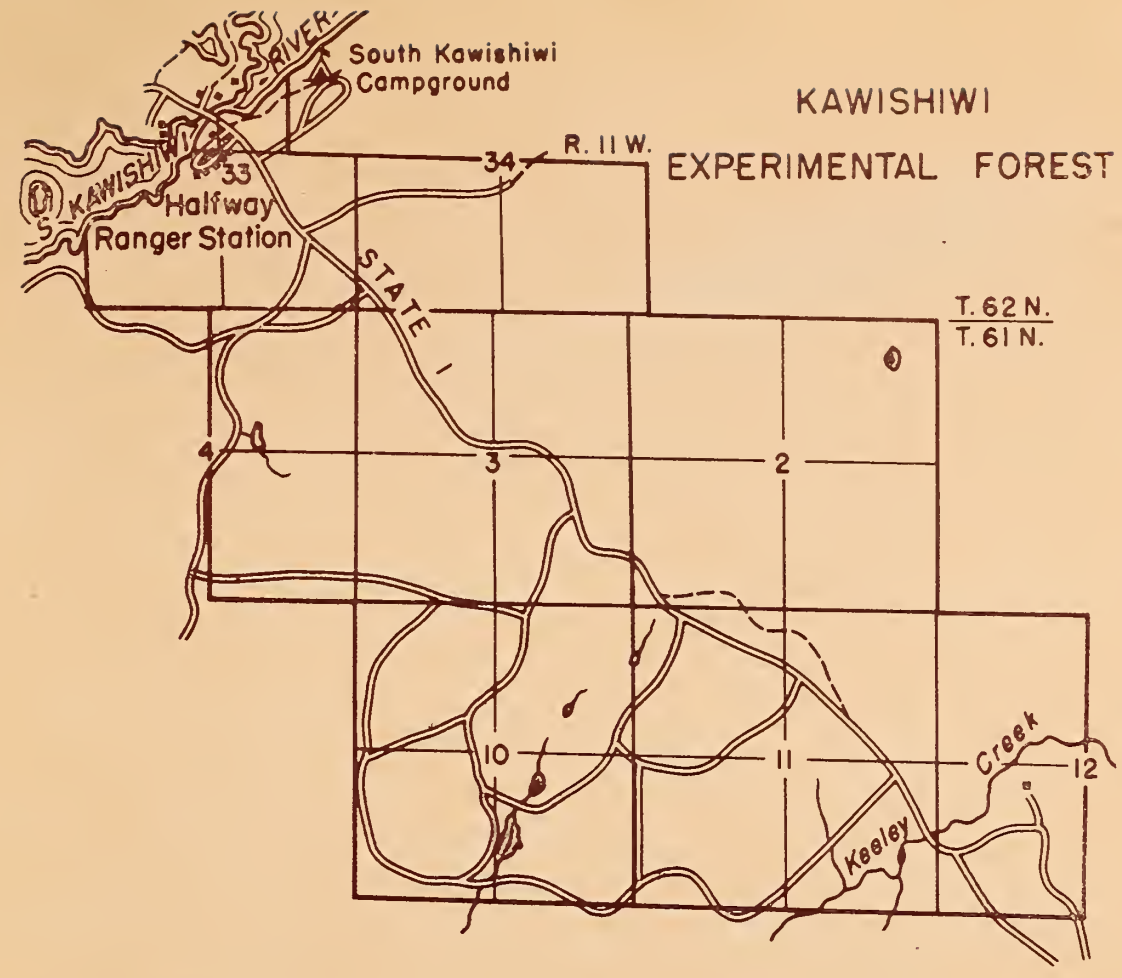
Thinning experiments are underway in immature balsam stands. This important work is being carried on in the central portion of the territory.

KAWISHIWI EXPERIMENTAL FOREST

The Kawishiwi Experimental Forest was created in 1931 mainly to study problems associated with the management of jack pine and red pine on the shallow rocky soils of the Laurentian Upland in northeastern Minnesota. This part of the state has a large area of mature jack pine in serious need of cutting. Experiments showed that due to excessive loss of reserved trees, clearcutting was the only method feasible in mature jack pine. It was also found that jack pine slash contains an abundance of good seed which will restock cutover areas if some effort is made to expose the mineral soil. (See soil treatment studies in the south half of the southeast quarter of section 3.)

Black spruce management is another problem being studied on the Kawishiwi. This species occurs on both upland and swamp soils in northeastern Minnesota. Cutting experiments, established in 1934-35 in the north half of the southwest quarter of section 34, have indicated that partial cutting works well in near-mature stands of swamp spruce but is not feasible in upland stands because of windthrow.

During the early thirties, planting tests were established on 40 to 50 acres southwest of



the headquarters site. These thriving young stands show what can be expected of the native conifers in this part of Minnesota when they are given early and frequent release and protection from deer and hares.

OTHER WORK OF THE HEADWATERS RESEARCH CENTER

There are also a number of plots and experiments being followed by the research center that are located outside the experimental forests. Some predate the experimental forests, and others were located to take advantage of conditions or activities unavailable on the experimental forests.

Jack pine management experiments, many of them long standing, account for a good share of these outside plots. These include non-commercial thinnings at 5, 10, 20, and 25 years of age; commercial thinnings and intermediate cuts at age 30 and older; and several harvest cuttings. There are also some intermediate cutting plots in red pine and white pine.

Quite a little research has also been done in stand improvement, particularly on the effects of releasing red pine, white pine, and spruce from overhead competition, and two swamp drainage projects were put in early in the program.

Regeneration studies have come in for a good deal of attention. These studies have dealt with combating brush and undesirable trees which compete with the planted conifers. Experiments have included use of heavy machinery and chemicals for soil preparation, planting and seeding. A few trials have been made using fire to prepare seedbeds for natural reseeding.

Better Forestry Through Research

The Headwaters Forest Research Center
The Lake States Forest Experiment Station
Forest Service, U. S. Department of Agriculture